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ON THE

## PATHOLOGICAL ANATOMY OF CHOLERA.

BY

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THE following statement is founded on the examination of eighty-nine fatal cases of cholera during the late epidemic, in the theatre of the Royal Infirmary of Edinburgh. In the course of my duties as pathologist to that institution, I have had unusual opportunities of contrasting and comparing the appearances in cholera with those presented to my notice in connection with other diseases; and the constant use of this *comparative* method of observation has led me to consider many statements as erroneous, which are generally, and in some cases all but universally, received in relation to this disease. The greatest care has been taken to verify or correct the results obtained by previous observers, more especially where any theory of the disease appeared to be involved; microscopical analysis and chemical tests have been applied wherever they promised to aid in the investigation; and in regard to such doubtful points as appeared likely to acquire precision by numerical analysis, the results have been preserved in the tabular form.

The bodies opened were mostly from the cholera hospital, being taken at random from those who died under the care of Dr W. Robertson; a few, however, were from the Infirmary. The proportion of females to males was 2 to 1. The average age of the patients was thirty-three, by far the greater number being between twenty and forty. Four of the females were in different stages of pregnancy; but as the greater number of the bodies of females known to be pregnant were given to Mr Goodsir by his special request, this number does not give an accurate idea of the large proportion of pregnant cases. Several of the females had been nursing, as was shown by the distended mammae, which readily yielded milk on pressure. The great majority of the bodies examined were evi-

dently those of persons previously healthy and vigorous. They presented the external appearances, so well known in cholera, of lividity and collapse, the last being caused by the shrinking of the cellular tissue from the absorption of its watery parts; there was, however, no diminution of the fat, which was usually in very considerable quantity on the abdomen and elsewhere. The muscles were of good colour, and usually in strong tonic contraction from the rigor mortis. The more important facts resulting from the examination of the internal organs are embodied in the following conclusions :—

I. *Previous Diseases of those attacked.*—Cholera appears, during the late epidemic, to have attacked chiefly persons in health, or in the retrograde stages of chronic affections; and to have spared almost entirely those affected with acute or actively progressive disease. Appearances of acute disease were chiefly observed when death took place after more or less distinct reaction, and were evidently the *sequelæ* of the choleric affection. The chronic lesions were exactly similar in kind to those most commonly found in hospitals and dissecting rooms, but bore a decidedly lower proportion than is usual to the whole number of cases examined. Thus the lungs had the traces of old disease in one-sixth of the cases; among which two only (cases of miliary tubercle) indicated progressive disease. The liver presented a chronic lesion in one case; the kidneys in four, of which only two (incipient Bright's disease) were progressive. The uterus and ovaries were frequently more or less abnormal, but the only progressive lesion was ulceration of the cervix, usually quite superficial. The intestines were uniformly exempt from chronic disease. It thus appears that the opinion which has been so extensively prevalent since 1832, that cholera attacks chiefly or exclusively individuals of unsound constitution, or bearing the traces of previous organic disease, is not borne out by the facts of morbid anatomy; and in particular, that there is no evidence whatever that previous disease of the intestinal canal pre-disposes to cholera.

II. *The Blood* is much less affected in its physical characters than is usually supposed to be the case in cholera. Its coagulation within the vessels takes place much as in other diseases. In the majority of instances, firm clots are found within the heart, more or less completely decolorised; and the serum or non-coagulated portion contains the greater part of the blood-corpuscles. The colour of the blood presents nothing unusual, the epithets "dark" and "venous" being in no degree more applicable to cholera blood after death than to that of every ordinary form of fatal disease. The remarkable viscosity of the serum (or portion of the blood not involved in the clot) so often noticed, was chiefly observed in cases fatal during the collapse or early reaction; and was certainly owing to the removal of the fluid matter by the intestines. The effect of



this in modifying the chemical constitution of the blood has been fully shown in Dr Robertson's researches ("Monthly Journal," May, p. 764). The microscopic appearances of the blood presented nothing unusual.

III. Much importance has been attached to *Congestion* in relation to the pathology of cholera. But it is an error to conceive of congestion as an essential or universal condition in this disease; for, although the lungs and right side of the heart are frequently loaded with blood to a considerable extent, the liver, spleen, and kidneys are, in most cases, paler than is usual in other affections. The intestines present every shade of colour from the palest to the deepest. The uterus and Fallopian tubes are generally loaded with blood. The venous system of the brain, and indeed the great veins generally, are also in most instances full. But such appearances are very common in other forms of fatal disease.

IV. A tendency to *Ecchymosis* in various situations was certainly characteristic of cholera to an extent not common in other fatal diseases. These ecchymoses seldom occurred externally, except in one situation, viz., beneath the conjunctivæ of the eyes, which were very commonly more or less bloodshot. Among the internal organs it was more frequent on the intestinal mucous membrane, especially of the colon, than in any other situation; but very frequent also in the form of petechiæ on the posterior surface of the heart, and occasionally in other places, as the cellular tissue surrounding the cervical vessels, and in that around the dura mater of the spinal cord. Perhaps there were other situations in which ecchymoses might have been found on examination; but in the above it was so frequent, that in only six out of twenty-six cases was it not found in one or more of them.

V. The *Glandular Secretions* in cholera are probably more or less diminished in quantity (although there are no very precise observations on this point); and they appear also, from the observations of Dr D. Maclagan<sup>1</sup> on the milk, and of Dr J. W. Begbie<sup>2</sup> and

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<sup>1</sup> See Dr Robertson's account of the Practice in the Cholera Hospital, in the "Monthly Journal," Dec. 1848, p. 394.

<sup>2</sup> Dr J. W. Begbie has made a very extended series of observations on the urine voided in the earlier periods of reaction, from which it appears that the urea is generally much diminished, and in some instances entirely absent; and that albumen is almost invariably present in greater or less amount, together with epithelium, for a variable period after the commencement of reaction. The presence of albumen was noticed at a very early period in the Edinburgh epidemic, and has since been extensively observed in the Parisian hospitals. Dr Begbie also informs me that various other modifications of the urinary secretion have been observed by him; in particular, a reaction with nitric acid indicating the presence of bile.

other observers on the urine, to undergo great alterations as to quality. But with the exception of the urinary secretion, which in the collapse appears to be nearly, if not altogether suspended, there is no evidence that any of the more important and constant glandular secretions are suppressed in any stage of this disease. The milk could be readily expressed in streams from the ducts, even after death, in nursing women. All the other glands preserved their natural appearance and structure, and the lymphatic and mesenteric glands contained a secretion which presented the normal microscopic elements.

Next to the suppression of urine, the suppression or retention of the bile has been assumed (on account of its apparent absence in the dejections) to be one of the most characteristic features of Asiatic cholera. The assertion that the bile is suppressed, however, is obviously incorrect; and it is only wonderful that this idea has not met with more positive discouragement by pathological writers. In the late epidemic, in every instance, except two, the gall-bladder contained more or less of bile, which was mostly of good colour and consistence; and, in the greater number of instances, in quantity sufficient to produce considerable distension. One of the exceptional cases was the one formerly referred to, of diseased liver, in which the gall-bladder contained only a thin light-coloured fluid; in the other, abundance of bile was present in the duodenum and stomach. The gall-ducts were most frequently empty, but occasionally contained bile; a probe passed in all cases easily from the duodenum to the gall-bladder, being usually somewhat tightly grasped at the neck of the latter, as is invariably the case, whatever be the cause of death.<sup>1</sup> The duodenum contained, in most cases of collapse, no appearance of bile; but there were, nevertheless, several cases in which the characteristic green colour was present in greater or less amount in the contents of the duodenum and stomach, though not in those of the intestines generally.

It appears, therefore, clear, that the non-bilious character of the evacuations cannot be due to non-secretion. It must, therefore, be ascribed to retention of the secreted bile in the gall-bladder. But it may well be doubted whether this retention can be rightly regarded as any part of the pathological process in cholera. The quantity of bile which passes into the duodenum, under ordinary circumstances, in the absence of the natural stimulus of food, is probably very small; and the quantity which appears in the feces in the normal state, or even under an ordinary attack of diarrhoea, would be quite insufficient to tinge visibly the enormous quantity of fluid thrown off by the intestines in cholera. Further, the ex-

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<sup>1</sup> This constriction at the neck of the gall-bladder is probably due to an elastic tissue. It has been frequently mistaken for *spasm* of the gall-ducts, a condition which I believe, *as far as post-mortem examinations are concerned*, to be purely imaginary.



amination of the cholera dejections chemically shows that biliary colouring matter can frequently be discovered in them by the nitric acid test, when it is not appreciable otherwise;<sup>1</sup> and it is fully proved by the *post-mortem* appearances, that bile is occasionally found in appreciable quantity in the duodenum during the collapse state (though to a more considerable extent during the reaction). From these circumstances it seems probable that the secretion of the liver is discharged into the intestines in cholera to quite as great an extent as in most diseases in which digestion is totally interrupted, or as in a healthy individual when fasting; and that its ceasing during the collapse to colour sensibly the dejections, is the consequence of its extreme diffusion through the mass of fluids in the intestines.

Repeated microscopic examinations of the liver revealed nothing unusual. The kidneys, however, appeared in many cases to have undergone morbid changes, the cortical substance being pale and turgid, and the tubuli uriniferi gorged with imperfectly developed epithelium, which was mostly loaded to an unusual extent with oleo-albuminous granules. A similar state of the kidneys occurs after scarlatina, and not unfrequently after typhus fever, and some other acute diseases.<sup>2</sup>

The secretions of the serous membranes appeared to be diminished in quantity, and everywhere more viscid than natural; an effect probably of the altered constitution of the blood.

VI. *The condition of the Intestinal Canal and its Secretions* demands special notice. The most frequent of all the abnormal conditions of the mucous membrane was the prominence of the intestinal glands, both aggregated and solitary, but especially the latter. This condition, the *psorenterie* of some French writers, was found in about two-thirds of the cases. The great frequency of patches of ecchymosis in the intestines, especially in the cæcum, has been

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<sup>1</sup> Dr Parkes seems to doubt whether the matter indicated by this reaction is bile; but neither does he admit it to be uric acid, the only substance which has been alleged to have caused confusion. The principal reason stated for his scepticism is that "there is a remarkable retention of this product (bile) in cholera, as in dysentery." It will be at once obvious that this is the very pre-conception against which I am arguing. See the "London Journal of Medicine," Feb. 1849, p. 143.

<sup>2</sup> I am indebted to my friend, Mr Alexander Borthwick, now in Dumfries, who studied along with me very carefully the condition of the different organs in cholera as compared with the miscellaneous cases which came under our notice, for tabular statements which show quite satisfactorily the much greater comparative prevalence of an excessive quantity of oleo-albuminous exudation in the kidneys of cholera patients, than either in the liver or the heart, which were in this respect below the average. None of these cases, however, with the exception of those alluded to in a former part of this communication, presented the granulations of Bright, or any other unequivocal marks of a chronic disorganisation.

already alluded to; in these cases the intestinal contents were usually more or less tinged with blood, and presented blood corpuscles among their other elements under the microscope. The ecchymosed patches were distinctly circumscribed, in tint varying from claret colour to the deepest purple, approaching black, but in parts not unfrequently greenish or ash-coloured; their surface presented a similar appearance, in all but colour, to the rest of the mucous membrane, and was not perceptibly elevated. In three instances, however, a different appearance was observed in the colon, the mucous membrane presenting a few flattened elevations, each over the extent of about a sixpenny piece, of a greyish or leaden colour. These elevated patches were evidently due to a sub-mucous exudation (probably identical with the diphtheritic exudations described as occurring in cholera by Virchow), and yielded on section a creamy fluid; in this fluid microscopic examination showed no well-marked pus-corpuscles or complete cells, but a number of nuclei, on which acetic acid produced no effect. In one protracted case, in which the great intestine was much ecchymosed, there were traces of dysenteric lymph on several parts of the mucous membrane. In two other instances, there was distinctly exudation of yellowish lymph, with heightened vascularity on the external serous surface of several folds of small intestine.

On the other hand, it was by no means uncommon, especially in early fatal cases, to find the intestines throughout natural in colour and appearance, or even paler than natural; and in many of these cases there was no prominence of the solitary glands.

The intestinal contents resembled closely at first sight the well-known cholera stools. In their most characteristic appearance they were yellowish-white, but frequently acquired, from blood on the one hand, or bile on the other, various shades of orange and greenish colour. On microscopic examination, the intestinal contents invariably showed immense quantities of perfect epithelium, sometimes in coherent masses, peeled from the mucous membrane, and preserving the form of the villi and follicles to which it had been attached. The existence of epithelium in the fluids found in the intestines in cholera has been noticed by Boehm (see "Medical Times," June 24, 1848), and other observers, and has been supposed to indicate a complete desquamation of the intestinal epithelium as one of the special pathological conditions of cholera. In reality, however, the appearance proves precisely the reverse; for the presence of epithelium in such large quantities in the fluids found in the intestines after death, is the result of purely mechanical maceration upon a mucous membrane to which, during life, the epithelium remained attached. That this is the case is proved by these facts—1st, That artificial maceration produces a similar result on a healthy mucous membrane; 2d, That the epithelium found in the fluids of each division of the intestines is always that of the particular part where it is found; 3d,



That the true cholera stools, *passed during life*, contained so little perfect epithelium, that it cannot be considered as anything more than an accidental ingredient.<sup>1</sup>

The examination of the cholera-stools leads to much more important and less confusing results than that of the intestinal fluids after death. These discharges separate by filtration, or on standing, into a colourless, or slightly coloured fluid, of an alkaline reaction, and a flaky sediment. The former is usually of a specific gravity from 1005 to 1010, and contains, therefore, a very small proportion of solid matters; these have been shown by Dr Parkes to consist chiefly of salts. Repeated examinations of this fluid have shown during the late epidemic (as Andral showed in the former) that albumen, as tested by heat and nitric acid, is not necessarily present in it. Indeed, the presence of albumen usually coincided with that of a small quantity of blood, which, as before-mentioned, is frequently present. The fluid, however, contains *constantly* a small quantity of an organic substance which is precipitated by alcohol, by corrosive sublimate, and (when acidulated), by ferrocyanate of potash; and which presents, in other respects, the chemical reactions of mucus.<sup>2</sup>

The flakes which form the sediment of the cholera-stools, have likewise the ordinary chemical reactions and physical properties of mucus. They are, however, opaque and turbid, and when submitted to the microscope, show a hyaline finely-striated basis, involving numerous granules, nuclei, and cells. The granules and minuter molecules require no particular description. The nuclei are from 1-250th to 1-180th of a line in diameter, circular or slightly oval, and not affected by acetic acid. The cells are comparatively few in number, mostly globular, seldom exceeding 1-150th of a line in diameter. Some of them are but little affected by acetic acid, and single-nucleated; others present all the appearances of perfect pus cells, being two, three, or even four-nucleated, and having the cell-wall rendered very transparent by

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<sup>1</sup> A similar conclusion, in regard to the desquamation of epithelium, has been maintained by Dr Parkes, in an elaborate article on the *Intestinal Discharges in Cholera*, in the "London Journal of Medicine" for February last. Although there are many opinions in Dr Parkes' paper from which I differ, it affords me much gratification to observe, that the principal facts included in the description of the cholera-masses by himself and his colleagues, correspond so nearly with what I have myself observed.

<sup>2</sup> M. Mialhe calls this substance *albuminose*, and considers it as "the ultimate product of the digestion of albuminous substances," (See "L'Union Médicale," 5th April 1849). His pathology of cholera is founded on the alleged presence of albuminose in the blood, which assertion, however, he does not appear to have attempted to establish by experiment. I prefer, therefore, the more familiar term of mucus, which is perfectly applicable to this substance, and was used by Andral, to one which is associated with a very doubtful hypothesis. The nearly allied chemical relations of mucus and the protein-compounds are well known.

acetic acid. The most common appearances, however, were the nuclei without cells above-mentioned.

Any one who is familiar with the pathological phenomena displayed by mucous membranes in a state of irritation, will readily recognise the similarity of the above microscopical appearances to those of ordinary catarrhal discharges from any of the mucous surfaces of the body; the chief peculiarities of the choleric fluid being the enormous exaggeration of the watery and saline matters evacuated, and likewise the smaller tendency to the discharge of albumen, and the development of pus-corpuscles, which are so readily formed and thrown off from a mucous membrane in a state of ordinary irritation.

The effects upon the blood of the removal of the watery and saline constituents are well shown in Dr Robertson's analyses; and it is probable that a considerable amount of the albumen of the blood also passes away by the intestines, in the form of mucus, which is nearly allied to it in composition, and which, as has been shown, forms the organic basis of the choleric evacuations.

VII. The *Nervous System* presented no lesion worthy of remark. The pia-mater of the brain and spinal cord were often considerably injected, especially that of the cord, which, from the position of the body after death, almost always presents this appearance. The spine was, however, only opened in four cases; and in one of these, there were found small calcareous plates upon the arachnoid of the cord—the most frequent, probably, of all its chronic lesions. The sympathetic ganglia, and the pneumo-gastric nerves, were repeatedly examined; but nothing unusual, except in a few cases slight ecchymosis, was discovered.